

- (c) forming an impurity layer in said conductor layer after a portion of the conductor layer has been deposited, said impurity layer having a melting point temperature and surface tension less than that of said conductor; and
- (d) heating the conductor layer to a reflow temperature, said reflow temperature being sufficient to cause the layers to reflow.

REMARKS

1, 30-35, 37-44, 46-56, 58-62, 64 and 65 are currently pending in the Application. The Applicant has amended claim 1 to place the case in better condition for appeal, should appeal be required.

In a Final Office Action dated January 8, 2003, claim 1 was rejected under 35 U.S.C. § 112 because of a lack of antecedent bases for the recitation of "conductive material." The Examiner rejected claims 1, 30-35, 37-41, 43-44, 47-56, 59-61 and 64 under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent No. 5,897,370 to Joshi et al. ("the Joshi reference"). Claims 36, 45, 57 and 63 are listed in the rejection, but those claims are no longer pending. Claims 42 and 62 were rejected under 35 U.S.C. § 103(a) the combination of Joshi and U.S. Patent No. 6,040,020 to Sandhu ("the Sandhu reference"). Finally, claims 47 and 65 were rejected under the judicially created doctrine of obviousness-type double patenting based on U.S. Patent No. 6,281,104, which issued from an application that is related to the present application.

The Rejection Under 35 U.S.C. § 112

Claim 1 refers to the deposition of a “conductor layer.” This conductor layer was inadvertently referred to later in the claim as “conductive material.” Claim 1 has been amended to change the expression “conductive material” to “conductor layer.” Accordingly, withdrawal of the rejection of claim 1 under 35 U.S.C. § 112 is respectfully requested.

The Double Patenting Rejection

The Applicant respectfully submits that the double patenting rejection of claims 47 and 65 based on the Applicant’s U.S. Patent No. 6,281,104 is premature as there has been no indication by the Examiner that the rejected claims set forth allowable subject matter. The Applicant reserves the right to contest the double patenting rejection of claims 47 and 65 when the presence of allowable subject matter is indicated. Accordingly, the double patenting rejection of claims 47 and 65 is not discussed further herein.

The Rejections Under 35 U.S.C. § 102

As set forth above, the Examiner rejected claims 1, 30-35, 37-41, 43-44, 47-56, 59-61 and 64 under 35 U.S.C. § 102(e) as anticipated by the Joshi reference. In support of the rejection, the Examiner referred to the text of a previous Office Action dated August 22, 2002 (Paper No. 6), which states:

Claims 1, 30-36, 37-41, 43-45, 47-57, 59-61, 63, and 64 are rejected under 35 U.S.C. 102(e) as being anticipated by Joshi, et al. (US 5,897,370)(“Joshi”).

Joshi discloses the steps of providing a substrate comprising a contact hole in a dielectric layer which exposes a portion of the substrate (col. 6, lines 46-55 and

65-67), depositing conductive material comprising aluminum (col. 5, lines 35-48), depositing an impurity into the conductor which lowers the melting point of the conductor and reflowing. The impurity comprises Ge, the temperature of the reflow is within the range recited in the instant claims (col. 8, lines 1-8).

Office Action of August 22, 2002, page 3.

In the present Final Office Action, the Examiner added to this rejection by stating:

Applicant has amended to include the limitation “after a portion of the conductive material has been deposited.” It is believed that Joshi et al includes this limitation, as the germanium layer can be deposited and then a further layer of conductor deposited (col. 13, lines 1-4).

Final Office Action, page 2.

The Applicant respectfully traverses the rejection of independent claims 1, 30, 40, 48 and 60, and the claims dependent thereon, based on Joshi. Each of these independent claims recite that the introduction of impurities into the conductor region occurs “after a portion of the conductive material has been deposited.” Respectfully, the Applicant asserts that the Examiner has misinterpreted the teachings of Joshi *vis à vis* the Applicant’s claimed invention.

The passage of Joshi referred to by the Examiner states:

The step of flowing a gas preferably includes selecting GeH₄. Preferably, the method also includes a step of flowing a gas containing W after the step of flowing a gas containing germanium to form a hard cap.

Joshi, col. 13, lines 1-4.

The Examiner relies on this passage to show that Joshi teaches the deposition of a portion of the claimed conductor layer or conductive material after the introduction of a germanium gas. This interpretation is not consistent with the teachings of Joshi as a whole.

Joshi refers to the use of W (tungsten) to form a hard cap for surface passivation or wear-resistance, *not as part of a conductor layer as exerted by the Examiner*. Specifically, Joshi states that:

Secondly, if a hard cap is needed for surface passivation or a wear-resistance application, the gas GeH_4 followed by WF_6 can be used to produce an in-situ hard cap of W_xGe_y .

Joshi, col. 1, lines 23-26.

Joshi additionally states that:

In another embodiment of the invention, once the material flow is achieved, a W—Ge layer 30 or the like is preferably deposited over the refractory material layer and the metallization, as shown in FIG. 4. The W—Ge layer 30 is advantageously used as a hard, wear-resistant polishing stop (e.g., it will be more resistant to an alumina slurry or the like in ferric nitrate used in chemical-mechanical polishing or the like).

Joshi, col. 8, lines 15-22.

The use of Joshi's disclosure of employing a layer of tungsten alloy as a wear-resistant polishing stop is not properly equated to the Applicant's claimed operation of "forming an impurity layer in said conductor layer *after a portion of the conductor layer has been deposited*" and the additional action of "heating the conductor layer to a reflow temperature, said reflow temperature being sufficient to cause the layers to reflow." In context, Joshi clearly does not intend that the layer of tungsten alloy to be part of the conductor, whose formation is assisted by the introduction of the germanium gas. Accordingly, the rejection of claims 1, 30-35, 37-41, 43-44, 47-56, 59-61 and 64 under Section 102 based on Joshi is improper. The Applicant

respectfully requests withdrawal of the rejection and an indication of the allowability of claims 1, 30-35, 37-41, 43-44, 47-56, 59-61 and 64.

The Rejections Under 35 U.S.C. § 103

The Examiner rejected claims 42 and 62 under 35 U.S.C. § 103(a) as being obvious over Joshi in view of Sandhu. In support of this rejection, the Examiner referred to the text of a previous Office Action dated August 22, 2002, which states:

Claims 42 and 62 are rejected under 35 U.S.C. 103(a) as being unpatentable over Joshi et al in view of Sandhu et al (US 6,040,020).

Joshi does not teach GeF4.

Sandhu teaches the equivalence of GeH4 and GeF4 for a dopant (col. 4, lines 35-45).

One of ordinary skill in the art would have been motivated to have used GeF4 in the process taught by Joshi in view of the teaching by Sandhu of the equivalence of GeF4 and GeH4 as dopants.

Office Action, pages 3-4.

The Appellant respectfully traverses this rejection. The rejection of claims 42 and 62 under Section 103 is based on Joshi. As set forth above, Joshi does not teach, suggest or illustrate the requirements of independent claims 1, 30, 40, 48 and 60, and the claims dependent thereon. This is true for at least for the reasons set forth above with respect to the rejection under Section 102. Namely, independent claims 1, 30, 40, 48 and 60 recite that the introduction of impurities into the conductor region occurs “after a portion of the conductive material has been deposited.” This limitation is not taught, suggested or illustrated by either Joshi or Sandhu.

Thus, the combination of Joshi with Sandhu cannot render claims 42 or 62 obvious under Section 103.

For at least these reasons, the Applicant respectfully submits that claims 42 and 62 are not obvious over Joshi in view of Sandhu. Accordingly, the Applicant respectfully requests the withdrawal of the rejections of claims 42 and 62 under Section 103.

If the Examiner believes that a telephonic interview will help speed this application toward issuance, the Examiner is invited to contact the undersigned at the telephone number listed below.

General Authorization for Extensions of Time

In accordance with 37 C.F.R. § 1.136, Applicants hereby provide a general authorization to treat this and any future reply requiring an extension of time as incorporating a request therefor. Furthermore, Applicants authorize the Commissioner to charge the appropriate fee for any extension of time to Deposit Account No. 13-3092; Order No. MCRO:199--3/FLE (95-0057.03).

Respectfully submitted,

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APPENDIX

Amended Claims Shown With Revision Marks

1 (Once Amended). A method of processing a semiconductor substrate, comprising the steps of:

- (a) providing a semiconductor substrate having a surface with a contact formed therein;
- (b) depositing a conductor layer on the semiconductor substrate surface, wherein said conductor layer comprises a conductor;
- (c) forming an impurity layer in said conductor layer after a portion of the conductor layer [conductive material] has been deposited, said impurity layer having a melting point temperature and surface tension less than that of said conductor; and
- (d) heating the conductor layer to a reflow temperature, said reflow temperature being sufficient to cause the layers to reflow.